Community informatics design for digital social systems : The ultimate tool for a human digital age

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There are indications that contemporary information and communication fields (Computing, CSCW, HCI, Internet Research, Community Informatics, Social Computing, community Informatics, Science, technology and Society) are increasingly concerned with the *multiple aspects* in which ICT are part or used or designed. There is a paradigm shift, not only in the computing fields towards an anchoring of ICT design in human activity systems and social systems (Checkland, Ackoff, Jantsch, Churchman, Banathy, Warfield, Christakis, Bohm, P. Jones, A. Laszlo), that has been slowly gathering momentum over the past 30 years and is now beginning to move from the periphery of the computing fields to a mainstream current of programming and designing in different fields of science. The same paradigm represents a growing trend in communication and social sciences (Luhmann, Giddens, Bourdieu, leydersdorff). This trend will enable the convergence of cyber-physical systems and social computing, which will lead to the emergence of Intelligent Social Systems (smart communities, smart cities, virtual communities of practice, virtual collaborative networks) arranged through various objects including both social and physical things, that interact and collaborate with each other. While there is a growing recognition among information and communication researchers that computer systems are designed for social practices, the Internet still tends to be viewed as an artifact with the focus being on its technical and material aspects.

This paper explores the notion whether the social web is not only, as an artifact, an element of the ecosystems relationship comprising the social structure in which we evolve, but is also a *«social system»* informing an organizational or a social structure or an whole cultural context. This is because the Social Web has all the qualities (aspects) of a social structure and all the morphogenetic attributes of social systems. This is an ambitious hypothesis, as long as most of the social scientists could concede that the social web should be considered as a socio-technical system with certain social attributes, but not recognizing the fact that the social web is a social system. Most social scientists conceive the social web as the mechanism which sets in place the communicative sub-structures provided by the «Internet of people». Following the works of major scientists in the field of social systems, not only should we say that the social web is a true social structure, built on communication patterns and artifacts, but true social systems built with the aid of artifacts, being both the multi-aspectual context (space, time, cultural, economic, politics,) in large scale projects where human interaction is evolving. This paradigm shift is called *«Digital Social Systems»* and this

methodology is «community informatics design» (CID). This trans-disciplinary paradigm offers us the positions and practices which are analogous to our roles in real world functioning, which are deepened, extended, articulated and changed by use and co-design of ICT through multiple spaces in life-world.

The issues here are substantive and will have profound implications for the understanding of different computer fields, the complexity science and the coming age of *«social computational science»*. We are not only talking about human factors in computing or social issues of computers. We are not only speaking of certain human dimensions in engineering or in human interface design (HID) or in Human Computer Interaction HCI). Rather, the *«community informatics design of digital social system»* is involved in a profound re-thinking of the computing fields confronted with complexity sciences and social sciences. *It is a shift in emphasis from aspects of the hardware and software to the multiple modal aspects of the human, social and organizational contexts within which ICT is being used and designed.*

Computational social science, social computing and community informatics

*Computational social science (*Helbing,Pentlandand al.*)* is a fast growing research area at the intersection of computer sciences, complexity and systemic and social sciences, in which new approaches and computational methods are contributing to answer questions about society. The field is inherently trans-disciplinary and collaborative: communication specialists and social scientists provide models of the evolutionary context of human beings and insights into radical new research questions, data sources, acquisition methods, while systemic provides a world view on complexity and computer scientists contribute expertise in developing mathematical models and computational tools to build new socio-ecological systems. New, large scale sources of socio-demographics data, behavioral and communication patterns in virtual communities, and network big data form the heart of this trans-discipline, along with recent advances in machine learning, social media analytics, network evaluation, and natural language processing.

The older and related field of *social computing (*Kling, Iaccono, Sawyers,Hammond*)* deals with the process through which people interact with computational systems, analyzing problematic such as how and why people engage in user generated content and how to co-design systems that enables them to do so, at different levels from the local to the global. Like the emerging field of computational social science, social computing blends multi-methodology and creativity tools from machine learning, to evolutionary learning tools with the contribution of the social sciences and the computer fields. (Rob Kling).

Community informatics was born in different part of the world to help people appropriate the TICS in the service of communities. In Quebec (known under the name of «communautique» since1984),in Canada, the United states and in Australia, it became an autonomous field of research in the late 1990s from a group of researchers and practitioners concerned to enhance the possibilities for territorial and virtual spaces communities to contribute to the Information/Knowledge/Networking Society (Gurstein, Whithworth, Stillman, Bieber etc). Since ten years, it has extended its research community around the globe. During The World Summit on Information Society (WSIS, Geneva 2003 and Tunis 2005), the trans-disciplinary approach of CI has been chosen to look for the development of a corpus of knowledge mobilization and

participative action/research projects for enhancing the possibility of ICT for enabling and empowering communities of users/designers in the service of society.

Community informatics (CI) analyze ICT from quite a different perspective than more established domains of information science and practice, as for example, Information Science, Management Information science, Information Technology, Artificial Intelligence, HCI. *For CI the unit of analysis is not the traditional frontier of organizations or the cognitive space of interaction, but the collective action consisting in how to use ICT in evolving communities, epistemic communities, communities of practice, knowledge repository, cyber-infrastructure, large collaborative networks, social systems development and communities of innovation and co-design communities and from geographically based communities to post virtual spaces.* (Hai Zhuge)

Virtual communities cut across traditional organizational frontiers and have not only promoted the engagement of communities and their members in the social project of the Knowledge Society, according to the emancipating ideal of social and political science; but it has also come up with a large problematic, such as knowledge creation, knowledge mobilization for large scale project, multi-aspectual programming and design of social systems which are in 2015 of an outstanding relevance for the whole ICT domain.

Community Informatics (CI) and Social Informatics (SI) are both important scientific domains in the field of soft ICT. CI and SI may seem quite the same, but there are some differences. CI is a smaller knowledge domain with a less scope oriented cluster than Social Informatics. CI is actually exploring integration of discipline like media theories, cyber physical systems and Internet of Things, knowledge management and applications of networked computing to communities and online communities. *We envision and we wish that the three afore-mentioned fields (CSS, SI and CI) will converge, at least to some extent, in the foreseeable future. The convergence of CPS and social networking gives rise to the «Internet of Everything».* It will accelerate the emergence of a new paradigm we call *«Digital Social System».* This paradigm will provide us with a new definition of a multi-aspectual design we call «Community Informatics Design». This paradigm will also provide promising solutions to a variety of societal problems spanning many domains, such as e-health, e-learning, smart cities, knowledge mobilization for large scale projects, socio-ecological system, and social system design. In this context two questions arise: how to design community information systems and multi-space communication systems? How do communities such as digital social system engage in the design process across a multi-aspectual reality?

Systems design for communities online (Aldo de Moor) is a perfect example of the use of community informatics design for digital social systems (or computational social systems). Community informatics design extends its action far beyond just creating some technologies and offering them to member communities, assuming that they know what to do with them. Rather, it require making explicit the usage context of the digital media and technologies: What are the goals, the requirements, the workflows, the representations, the roles of the community members? What are the principles, such as harmony, sustainability, trust, authority, legitimacy, and transparency, driving communications and the configuration of their information and collaboration requirements? Parallel to the understanding of the usage context, a community informatics designer (a «*communautician*») must also understand the cost and constraints of ICT. The «communautician» also needs to learn how these creativity and design tools are linked, configured, and integrated into different conceptual spaces, articulating new social worlds or whole *communication spaces* that are more than the sum of their technological parts or the different building spaces, creating digital social systems that effectively support innovation and collaboration in diverse settings or situations with multiple stakeholders from different places. Understanding of the fuzzy requirements and the

wicked nature of the problems are also important as with the support of *computational media*, the interaction and the dynamic between different co-creation spaces are in a continuous state of flux. Community informatics design require the communauticians deep insight into the dynamics of the continuous co-evolution of the physical, cognitive, social, symbolic, technological spaces etc, that support the social systems activities.

 The ultimate goal of designing and co-building intelligent digital social systems, like virtual communities and innovation communities, is to improve the quality of life for all by exploiting ubiquitous intelligence. A digital social system will by nature feature the interplay between physical space, physiological space, mental and psychological space and sociological space. These different spaces should be conceived as different worlds converging around the co-design of the cyberspace, in fact the co-design of a new world through semantics links and transmedia narrative. This is consistent with a number of the various conceptions of «*world building*». A story in a videogame for example (a narrative), is seen as having an existence separate from the subjective understanding of individual users. This position corresponds to ideas expressed by both Habermas and Popper. Habermas (1984) recognizes three different worlds: the objective world of actual and possible states of affairs (physical world), the subjective world of personal experiences and beliefs (psychological world), and the social world of normatively regulated social relations (Gregor). These three worlds are related to Popper's Worlds1, 2, and 3 (Popper 1986). World 1 is the objective world of material things; World 2 is the subjective world of mental states; and World 3 is an objectively existing but abstract world of man-made entities: language, mathematics, knowledge, science, art, ethics, and institutions. Thus, a narrative as an abstract entity belongs to World 3. An individual can have a subjective view of what a story means, at which point an understanding of the story resides in a personal World 2.This position paper, however, is more concerned with theory as World 3 entities, existing outside an individual mind (as, for example, in journal articles) and beyond, in a distributed and collective mind. To sum up, this example of different perspectives on a story at a general level shows stories as abstract entities that aim to describe, explain, and enhance understanding of the world and, in some cases, to provide predictions of what will happen in the future and to give a basis for intervention and action. *These notions do not include cyberspace as a new communication space*.

Actually cyberspace has extended a new system thinking form and interaction pattern recognition, cooperation through different spaces of communication and modes of existence offline and online. *Different from a static classification, the different aspects of world building with design and creativity tools generate an evolving space model that emphasizes the socio-dynamics and the diversity of aspects in different spaces that constitute new worlds (multi-user video games, 3D modeling, business interactive network, virtual communities).* For example, the modality of the symbolic and social spaces evolves differently from the physical space, mental space, and cyberspace. The integration of a «*fourth world*» allows the user/designer to better understand multi-dimensional spaces where we can classify different aspects of the world evolving along the different spaces of representation and intervention in a research project or a scientific narrative. Spaces and aspects are different scientific or theoretical forms that help humans to make sense of the world.

The following sections explore the fundamental goals of community informatics design and world building in more depth, as well as the related issues of designing social systems as new social worlds.

Community informatics design: a multi-aspectual world building experience.

Since few years, the World Building notion (Mc Dowell) represent a technology that provides new trans-media tools to make film production more compelling and cost-efficient, also, it re-imagines trans-media storytelling as an interactive and shared experience in a different design situation : for example in e-learning or e-commerce. What is interesting for the designer of social systems (as new worlds) is that this approach reaches beyond film industry or video-games programming, towards new digital environment, for example micro-markets in marketing, medical imaging, data management, co-design of community within E-learning. What we have learned and experimented in our university master degree courses at UQAM, about the role of narrative in the history of mankind and the role of interactive storytelling with the aid of different computational media and platform in the cultural industries, is that this performative technology already or will be soon used in universities and schools, hospitals, offices and in organizations, and homes. The technologies and conventions that develop in the media industries will transform what counts for the user/designer as «authentic digital experience» in diverse design situations.

World building does to spaces what film does to time (motion, momentum, sequences). Digital world building is a major technical transformation in the different profession of design (participatory design, incentive design, value sensitive design, interaction design, and production design in film and advertising and now in community informatics design). In the same way that the physical sets and environment are created, we now have the computational technologies and social media to create, re-design and intervene in digital environment sets. Physical or material spaces have historically provided material basis for the generation and evolution of living beings. Humans have created various artifacts and spaces to make sense of the world. Social systems as social space of human activities have been evolving at the same time as the development of human beings, their institutions and architectures. Humans have invented different kinds of technology and co-created cyberspace with the development of ICT. Cyberspace is now being integrated to different individual actions and communities in physical *spaces and social spaces. A «complex communicational space» arises and is formed by cyberspace, the physical space, the mental space, and the social space.* The exploration and understanding of these spaces will be augmented by a global process of co-design by/in/and through different communities of practice. Digital social system design for innovation and quality of life needs a new methodology since the concepts, methods and applications specific to cyberspace, physical space, cognitive space and social space will not be appropriate and relevant for exploring the new «complex communicational space» being built at different scales. It is necessary to explore the basic concepts of «Community Informatics Design and «Digital social systems» and their particular and distinguishing characteristics, and scientific issues. Research on Digital Social Systems combining the Internet of Things and The internet of people (The Internet of everything) with the contribution of Digital world Building is a powerful metaphor to organize our digital world and the distributed governance of knowledge, will lead to a revolution of society, science, design and engineering.

Rules and conventions have changed

In fact, the rules have changed. The different professions of design practices are experiencing a radical paradigm shift. The rules, conventions and statics architectures of web 1.0 and Web 2.0 no longer exist. We now collectively design our future social systems. We learn in hospitals as in hotels, take vacation while doing scientific research and, teach while on vacation, socialize while working, just about everywhere. Designing spaces for «Digital social systems» is designing for

massive tangible and intangible variables through multiple aspects of programming and setting. The technologies and computational media that have enabled the rise of an «Internet of Everything», including machines, objects, aspects, and humans are causing a fundamental rupture in the ecosystem of designing and constructing digital environment. New innovative digital social systems (or computational social systems), creativity and design tools, and visual and natural languages adapted for storytelling through trans-media platforms are growing at a fast pace. They are introducing new levels of complexity never seen before. In the Internet of Everything under construction, those same systems or computational media and languages become part of what we can call a «social architecture», composed of different spaces, each of them contributing to the «world building» activities, and becoming part of a new digital system with its own «situational topology».

In the years to come, user experience design and «community Informatics Design» will combine with many other design approaches to explore and describe policies, strategies and tactics for designing and governing new digital social systems. Wicked problems and large scale wicked problematic, require tactics and actions that cross strategic spaces of digital social systems to create novel solutions, and user experience and /community informatics design experience as a user/community-driven designing methodology assuming humans interface and new social systems everywhere (H.R. Barker). As the semantic web parses meaning from Big Data and the internet of everything, communauticians explore convergence and divergence between social/philosophical and mathematical/programming systems of expression, to go beyond stylistic parametric systems of expression to meaningful parametric and modal expressions in multiples spaces and aspects. These solutions need world building strategies before designing for example, new innovative digital social systems.

We can define «Digital Social Systems» as multidimensional complex communicational spaces of action that evolves strategic and tactic subspaces to enable different persons and communities to interact around different purposes, reflecting on their practices or interacting directly or via computational media through cyber-physical-psycho-socio subspaces. Communauticians or Community Informatics designers interact with multiple stakeholders, define their different roles, try to coexist harmoniously in evolving and creating a new world, transform the spaces with a *«culture of goodness»* that fits between different subspaces, transforming these spaces and providing and governing the relevant information, in giving knowledge and services, collaborating with each other through multiple links and platforms, and self-organizing their social systems on-line according to their values and culture. In brief, *Digital social systems are new modes of existence in the form of a complex communicational space. Community informatics design is a science of engagement for transmedia world building and governance of knowledge in the different subspaces. Digital social systems intelligence helps in the understanding of the complex communicational spaces, integrating human intelligence, socio-intelligence, and machine intelligence. The understanding of collaborative intelligence and research on social systems of innovation with human augmentation systems like the computational media will contribute to world building activity in nature, individuals, and communities in the Knowledge Society.* (Hai Zhuge).

Transitions towards a Knowledge Society : multi-aspectual design framework

Information and Communication Technology (ICT) is aiding the transition of society into Information Society and ultimately Knowledge Society. Embedded within ICT are the cultural and philosophical undercurrents of the society in which the ICT solutions are developed, currently

predominantly the Western culture. The proliferation of ICT is therefore inadvertently leading to more *Westernization* of the world. It is important, therefore, that ICT solutions be culture sensitive and flexible enough to be situated within different cultures. To that end, we have used Herman Dooyeweerd's Theory of Modal Aspects to analyze a framework we have developed for implementation of locally and globally situated knowledge based systems, to determine its efficacy in addressing the different modal aspects, which make up the total experience and cultural expressiveness of societies: The «Computer Aided Community Informatics Design Systems (CACIDS).

Social and communicational sciences in computational social sciences will contribute to break the lack of an internal ethnographic critique within the computing disciplines means that the culture sensitive aspects of computing are left to chance and coincidence. Philosophy, however, provides a critical overview of the thoughts that shape a society and therefore can enrich the ethnographic considerations around computing and ICT.

Because philosophy itself is rooted in a specific culture, it was important to identify and establish a transcendental philosophical framework to guide the implementation of ICT solutions, in particular, knowledge-based large scale systems. For this task we have explored the work of Dooyeweerd and Basden and Klein, who identified 15 modal aspects (modes that we operate in within our experiential horizon) and articulates the nature, the properties and the relationship between the modal aspects. His work is taunted as "a philosophically sound basis for diversity and coherence, and interdisciplinary (in this case, intercultural)" [17]. The underlying principle in Dooyeweerd's thinking is *the shalom hypothesis* aka the *simultaneous realization of norms* principle. This principle highlights the need for operating within the laws of a modal aspect in order to maintain sustainability and a deep, rounded, rich well being [8]. An extensive overview of the theory of modal aspects by Dooyeweerd is in his magnum opus "A new Critique of Theoretical Thought" [8] and "In the Twilight of Western Thought" [6]. Dooyeweerd identified the following 15 modal aspects: Quantitative, Spatial, Kinematic, Physical, Biotic, Sensitive, Analytical, Formative, Lingual, Social, Economic, Aesthetic, Juridical, Ethical and Pistic. Dooyeweerd's theory of modal aspects provides a tool for analyzing [17], shaping and assessing various undertakings on the basis of their overall good.

Aspectual overview of

We have developed a framework named, CACID (Computer Aided Community Informatics Design System), that we proposed for building multi-modal, multimedia and ontology based knowledge systems. CACID is a generic layered architecture that attempts to provide a basis for implementing locally/globally situated and culturally sensitive knowledge based applications. The framework has been utilized in implementing a prototype of a knowledge portal in the context of exploring ICT interventions for the development of diverse communities of practice in the Innovation Sector in Montreal Canada. A basic aspectual analysis CACID (Garon and Harvey 2015) highlights the key areas that are addressed at each of the different layers in reference to a trans-disciplinary framework named CAPACITEs). This analysis is a necessary critique that is needed to determine the adequacy of CACID as a balanced framework that is coherent across the diverse modal aspects, and across diverse cultures.

The key layers of the framework, for integrating the implemented applications and systems within a local culture of innovation, are the knowledge base layer (which encapsulates the specific knowledge of the community, with its embedded epistemological and ontological presuppositions),

the social networking layer (emulating the social systems within the community, and providing an interface to the human, as a participant in a community of Socially Intelligent Agents (SIAs), presentation layer (handling the primary interfacing to the users in a manner that conveys the user's aesthetics, preferences and sense of beauty and form) and the interaction layer handles the interaction based on the users' preferred usage modality (Harvey 2014). The CACID framework encompasses a variety of modal aspects, which allows for an intrinsic consideration of factors within the experiential horizon of the users of the system. Some aspects are less prominently addressed by the CACID framework because they only come into play indirectly, for example the economic, biotic, and political aspects.

Social architecture in CID : larger than user-centered design

Social, cultural and communicational solutions should be conceived as a multi-modal world building activities in different spaces of human activities generating Digital Social System that include the entire experience field of the users and communities. This philosophy of design is based on a human centric approach that tries to redefine the form, the scope, the socio-materiality and the purpose of various socio-technical systems designs approach. Instead of creating and constructing close spaces with definite frontiers, the process of-co-design (in community informatics design and apparent approach) should be conceived as a «work in progress», a social architecture where the modal aspects are considered as parameters of the life world of the users where sense making is at the center of the design situation. An expert designer in the context of World Building should now focus on setting the conditions of use and design in different emerging spaces to achieve some ongoing intelligent community purposes.

Multi-modal configuring assumes also non-teleological strategies, an emergent and responsive interactive engagement between multi-stakeholders and the environment. *Designing for emergence includes anticipating the future transformations in the range of the multi-modals aspects found and modeled in the different spaces of a collaborative platform or a digital environment. Multi-modals social and digital architectures are now expected to create an interactive, self-adaptive and auto-determined context to facilitate user's behavior, and accompany the different users/designers.* Beside the mathematical field of topology, models of soft «situational topology» in cyberspace should be developed to define continuous spaces of intelligent and collaborative experience between the traditional topological spaces that maintain topological properties of a given space, with the situational and virtual situational topology of digital social systems. With our colleagues of computational social sciences (hard social sciences), we can begin now to develop models of persistent spaces of experiences.

In this context, *design comprises the purpose of the communities of users/designers. Tools become tools of meaning and sensing for people. Things, objects, and human aspects become meaningful if you have a motivation for it, and meaning is closely related to the living spaces of a digital environment. This is a condition for the internet of everything to rise.* Meaning is created through multimodal experiences, relationship and individual and collective behaviors. The communication and collaboration for innovation and world Building are done through trans-media narrative and semantic linking through multiple spaces of interaction within new digital social systems. For example, we have used trans-media storytelling's that are appropriated structures or conventions that facilitate communication and meaning production in e-learning digital environment University of Quebec in Montreal. Finding the right rules, properties and formalism to communicate a desired meaning becomes an urgent task to create good human architecture for solving large scale problem

we are confronted with. In order to-co-design following the multi-modalities of knowledge mobilization in large scale project, the community informatics design community must integrate ontological and epistemological foundations into the research questions and the process of world building. The analysis and evaluation of the nature of meaning and knowledge within the building of «digital social systems», as well as fundamental questions of being and reality is essential in the act of designing meaningful and valuable spaces. In the future, we should consider essential to teach architecture in the social sciences through trans-media storytelling using parametric design tools, that way we can avoid the chasm between human needs and the digital spaces of the future social systems (R.H.Barker). Meaning creation through multi modal programming and design will lead to produce value and artifacts that become more relevant for our cultures. World building, narratives, trans-media storytelling platform and adaptive complex community informatics design can generate new digital social architecture that design better spaces of interaction with extensible semantic languages and fuzzy sets of dimensions and modalities that give to users/designers a powerful methodology to design innovative social systems. Linking situational topology, situational semantics, spatial semiotics, multi-aspectual programming, give us many possibilities to establish symbolic meanings in the digital ecosystem.

Conclusion : redefining architecture in digital social systems.

The current evident transition towards a global knowledge society has its share of (un) outcomes; assimilation of indigenouscultures, loss of diversity (and esthetic) through Western-influenced homogenization. We have highlighted examples of the limitations of a strict computer hard solution to be relevant and appropriate in different disciplines and cultures. In order to maintain harmony in the context of the diversity of cultures and philosophies, it is necessary to situate the ICT solutions on a transcendent philosophical framework, and for this we have proposed Dooyeweerd's theory of modal aspects. This philosophy can be used to analyze and shape ICT solutions (as exemplified through the analysis of the CACID framework, LCA UQAM) in a systematic manner to determine the coherency of the solution, as far as the overall good, quality of life and sustainability of a digital social system is concerned. The transition towards a global knowledge society needs to be coupled with an understanding and implementation of new mechanism in social architecture, in the computing fields and in social sciences.

As the multiple modalities of social architecture are analyzed, synthesized and co-designed, the digital precision that we find in computer science will be completed by the new parametric and multi-modal modeling of community informatics design with the help of the models found in the communication and social sciences. A new direction is proposed here for the adoption of a culture of world building with the aid of new social architectures, based on multiple aspects of a given digital world. Different spaces, (physical, psychological, social and cyber-spatial) could be designed to better serve the concerned communities. These spaces will evolve with the experts and users/designers and adapt in time and for a variety of uses in new digital social systems while stakeholders share information and data, or collaborate around different projects. Within this hyperspaces and subspaces, meaning is constantly and collectively produced. The multimodal aspects foundations of community informatics design challenge the experience of the users and the skills of the designers. The new creative and computational tools of world building challenge both the hard and soft sciences. Digital Social Systems spaces of interaction are communication by nature and their architectures must be able to adapt and evolve to augment the human consciousness in computational social sciences.